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THESIS

MICROCOMPUTER MANAGEMENT
POLICY FOR U.S. NAVAL FORCES

by

Donald S. Free

September 1985

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Microcomputers have become an integral part of business life in America and in the U.S. Navy. They can be used as stand-alone processors, components of a network, or terminals to more powerful mini- or mainframe computers. Microcomputers are a valuable resource and should be treated accordingly. The proliferation of microcomputers can not go unchecked by management. There must be a plan that will channel the power of the microcomputer (Continued)

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Microcomputer Management Policy for U.S. Naval Forces

by

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B.S., United States Naval Academy, 1978

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ABSTRACT

Microcomputers have become an integral part of business life in America and in the U.S. Navy. They can be used as stand-alone processors, components of a network, or terminals to more powerful mini- or mainframe computers. Microcomputers are a valuable resource and should be treated accordingly. The proliferation of microcomputers can not go unchecked by management. There must be a plan that will channel the power of the microcomputer towards the goals and objectives of the organization. The Navy is no exception. It too must deal with the proliferation of a new technology. The Navy must establish hardware and software standards for use throughout the fleet. These standards must be incorporated in fleet wide training plans so that fleet personnel can apply the standards in the accomplishment of their tasks. Through a comprehensive microcomputer management policy, the power of microcomputers can be used to accomplish the Navy's mission.

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I. INTRODUCTION

The introduction of the first computer into the Federal Government in the early 1950's was an attempt to increase government efficiency and productivity. Over the next 30 years the computer became an integral part of almost every facet of the Federal Government's routine. Government employees were paid by computer printed checks, census statistics were aggregated and manipulated by computers, and the Department of Defense (DOD) command control and communications system was computer controlled.

As the use of computers spread throughout the Federal Government, more and more people demanded access to computers. However, the demand for access to computer resources outgrew the data processing department's ability to provide users with satisfactory service. It was not uncommon for users to have to wait years for their applications to be developed and implemented. In some cases user requests were never acted on because of the large application backlogs.

In the late 1970's and early 1980's industry began to market small "personal computers". The first models were expensive and very limited in computing power and memory. Technology continued to improve these small computers. With

the mass production of small, relatively inexpensive microchips, the microcomputer industry was able to offer small, powerful, inexpensive, and independently operated microcomputers.

The microcomputer was viewed as a means to increase individual worker productivity and as a way to relieve the backlog of user applications. As the cost of microcomputers fell, and industry bombarded society with microcomputer advertisements heralding a more productive and efficient work force, thanks in large part to the microcomputer, microcomputers began to flood the Federal Government.

The helter-skelter infusion of microcomputers into the Federal Government has created a need for coordinated control of microcomputer acquisition. These controls will prevent the proliferation of a variety of incompatible hardware systems, and will allow for savings in purchase price through large volume sales. Additional benefits will be seen in reduced training time and costs as a result of standardized hardware and software. Most importantly, coordinated management will ensure that these valuable resources are properly employeed in accomplishing the organization's goals.

Although thought of as "stand-alone" or "personal computers", microcomputers should be considered as a computer system. Microcomputers represent a sizeable

investment of tax dollars. The results of a government wide survey show that 38,000 microcomputers were purchased in fiscal year 1984, a 450 percent increase over the previous fiscal year's acquisitions. The total dollars spent were $137 million, up from $34 million in FY 83. The largest single purchaser of microcomputers in the Federal Government in FY 84 was the department of the Navy (DON), which purchased 10,649 microcomputers at a total price of $28.7 million. [Ref. 1]

This study will focus on the policy of stand-alone microcomputer acquisition in the operating fleet of the U.S. Navy. The Shipboard Nontactical Automated Data Processing systems (SNAP I and SNAP II) will not be discussed. Only non tactical microcomputers will be addressed because computers used in tactical applications are covered under separate policies.

II. BACKGROUND

The use of computers has been and still is a dynamic process. Computers have evolved in technology and application since the first computer was introduced into the Federal Government in the early 1950's. At first computers were used for selected applications by a limited number of organizations and people. But as technology advanced, the cost of manufacturing computers fell. Computers became more numerous and their use became the norm rather than the exception.

The growth of computer use does not follow a linear path, it progresses through a succession of four stages.[1] The four stages of computer growth are: initiation,

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[1]Richard R. Nolan's original study of computer growth in organizations resulted in a four stage concept for the integration of computers by an organization. After more study of computer growth in organizations, increased experience in information system development, and new technology, i.e., database technology, Nolan expanded his concept from four to six stages. Nolan contends that the initial four stage concept continues to be valid, but because of a more complete view of organizational computer growth, the stage concept can be expanded to six stages [Ref. 2: p. 116]. In the six stage theory, Nolan states that a shift from management of the computer to management of an organization's data resources occurs "sometime in stage 3". This thesis is addressing the growth of microcomputer technology in the Navy, not as an integrated subset of the overall Navy computer resource program, but rather as a separate management issue. Therefore, when discussing microcomputer growth, Nolan's original four stage concept is germane.

expansion, formalization, and maturity [Ref. 3: p. 78]. The four stages of computer growth can be compared to the growth and development of a child.

When a child is born he is sheltered by his parents and is completely dependent upon them. As the child grows he becomes exposed to his environment and is allowed to explore and discover new things. Before the child oversteps his bounds, the parents try to channel his energies and direct his development in a manner they deem is most beneficial to the child. As the child matures he develops his own ideals and, is able to place his own controls on his development.

It has been observed that the development and integration of computer resources, when plotted over time follows an S-shaped curve, Figure 2.1. In this evolutionary process particular actions by management can be seen as marks that help to form the S-shaped curve. [Ref. 3: p. 77]

A. COMPUTER GROWTH

1. Stage 1: Initiation

When the computer is first brought into the organization there is no long range plan for its' implementation and use. Usually there has been no study on the long term effect of the computer on the organization. Computers are brought in initially to take on time consuming tasks such as inventory management and administrative functions, i.e., word processing, file management, etc.

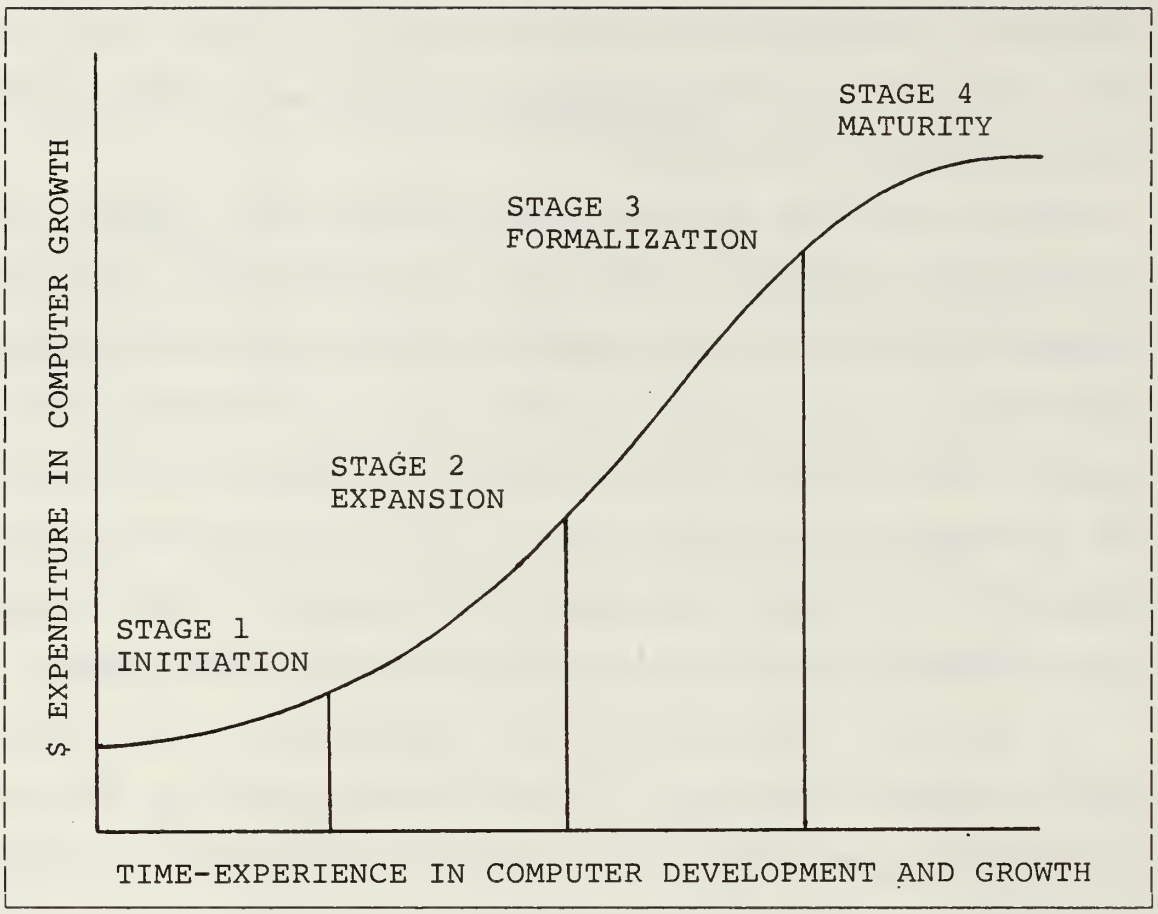

Figure 2.1 The Four Stages of Growth.

Location of the computer is solved in the short term by placing the computer in the department which will use the computer most, normally in the supply or administrative departments. Initially this step can be viewed as the best way to introduce the computer into the organization and ensure that it is available for its intended use. However, further into the future when access of the computer is desired by other departments, the controlling department may

be reluctant to give up its' control of the resource, a resource the department often times looks upon as its' own.

With the introduction of the computer resource comes the natural reluctance to change on the part of the employees and in some case "fear" of computers. People are afraid their jobs will be changed to the point where they can no longer do their jobs without retraining. A new system provides an opportunity for some members of the organization to excel and thus displace more experienced workers as the resident experts. In some cases, there is just plain fear of losing one's job to automation.

2. Stage 2: Expansion

In the second stage the organization experiences a rapid and uncontrolled growth in the use and acquisition of computer resources. The computer's original stage 1 applications have been tested and used. However, most computers are not fully loaded by the stage 1 applications. Because of the potential that exists in the computer and the interest generated by the initiation stage successes, the users and programers are eager to try new applications. While some of the programs are valid efforts to solve organization problems, many of the programs can best be classified as "wouldn't it be nice if . . . ." programs.

During this second stage top management has not become overly involved in the control of the computer

resources. As a result there are few constraints placed on the users and programers. The programers are not provided with sufficient guidance concerning what types of applications will best help the organization. When requests for work come in, the programers establish their own prioritization system. Often times the most challenging programming assignments (as viewed by the programers) are selected for completion before projects that will be of greater benefit to the organization.

As word of the work being done on the computer spreads throughout the organization, more people become interested in what the computer can do for them. The job load begins to increase for the programers. Because of the increased work load, more computer resources (personnel, hardware, software, and dollars) are requested to meet the increased user demands.

Without direction from top management, the growth experienced in stage 2 can be further characterized as uncontrolled. The computer budget begins to rise beyond that which the organization has anticipated, and perhaps can even afford. At this point top management realizes that the computer resources need to be better controlled, and so top management becomes involved in the organization's computer resource programs.

3. Stage 3: Formalization

As the organization moves from stage 2 to stage 3, top management, realizing that the computer budget has gone out of control, attempts to exert more control over the organization's computer resources. Often times this step is an over reaction, and is manifested by a policy of centralized control of the computer resources.

The new controls are not initiated in order to redirect the organization's uses of its computer resources towards accomplishing organizational goals and objectives, but rather to halt the growth and to bring the rising cost of computer resources to an acceptable level. Strict rules on the use and acquisition of the computer resources are implemented. Initially a moratorium on further acquisition and expansion is instituted. After management becomes comfortable with their knowledge of the resources, more acquisitions and expansion is permitted.

Changes in personnel often occur as a result of the new control from the top. In some cases management decides that the people who were incharge of the computer resources should be held responsible for the uncontrolled growth of stage 2 and should be replaced. However, there are people who can not or do not, after becoming accustomed to working more or less on their own, want to work in an environment so strictly controlled from above.

Stage 3 can be characterized by a taking of control of the computer operation by top management. Growth in acquisition and new applications work slows down, while the budget is brought under control and the computer organization is brought in line with organization objectives. Additionally there are changes which involve the personnel and placement of the computer resource organization.

4. Stage 4: Maturity

In stage 4, the mature stage, the computer operation has established itself as a key element in the organizational structure. The head of the computer department is responsible for the development and growth of his department in parallel with organizational development and needs. However, the computer department's growth is not just in reaction to top management guidance. The computer operation department head has risen to a position where he has a say in the organization's development. Because of his new prominence and the benefits his department can provide to the organization, his ideas are sought out when discussing the role of the computer department in the organizational structure.

The computer budget has been brought under control, department personnel are working with a clear set of operational guidelines, and management has established priorities and standards. Other departments are informed of the

computer department's resources and capabilities. The computer has become a resource for the entire organization to use and benefit.

B. THE FOUR STAGES

The four stages of computer development are not a complete description of an organization's entire computer program. While the organization as a whole can be in stage 4, a division of the organization can be in stage 2. A similar analogy can be made with different sizes of computers. The organization can be in the mature stage of its mainframe program, in stage 3 of the minicomputer program, and in stage 2 of the microcomputer program.

By examining the 4 stages of computer growth, many of the hardships experienced during mainframe integration can be bypassed or at least minimized. By applying the lessons learned to the microcomputer program, the organization will be better prepared to assimilate microcomputers into the work routine.[2]

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[2]Nolan's four stage theory of organizational computer growth was originally developed in the early 1970's. Although the initial sample of observed organizations was small, further study of 35 additional organizations and a variety of IBM customers and other corporations produced results that supported Nolan's original conclusions on computer growth, as well as allowed Nolan to expand from four to six stages of growth [Ref. 2: p. 116]. Studies by H. C. Lucas Jr. and J. A. Sutton [Ref. 4], and by Robert C. Goldstein and Ian B. McCririck [Ref. 5], on the validity of Nolan's theory as a model of organizational computer growth were unable to confirm Nolan's hypothesized S-shaped curve.

C. MICROCOMPUTERS IN THE NAVY

The Navy has become a large user of microcomputers. Like any organization, the Navy is experiencing "growing pains" in assimilating microcomputers into the work force. The Navy is progressing through the four stages of ADP growth, but in a more controlled manner.

The introduction of microcomputers into the Navy coincided with the introduction of microcomputers into the market place in the late 1970's. Microcomputers slowly came into use as technology evolved and microcomputers became affordable. Initially microcomputers were purchased for word processing, spread sheet, inventory control, and data base management applications. (These are still the dominant applications for use of requested microcomputers cited in

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However, it may be that the results of the later studies were due to the inability of the independent variables to capture the essence of Nolan's concept, and because the six stage concept was a result of overlapping the original 4 stage model and Nolan's 4 stage model of the growth of data-base technology. Although challenged by these studies, neither study was able to show significant evidence disproving Nolan's stage theory of organizational computer growth. It remains that Nolan's model is still a useful tool of information systems managers upon which they can build a framework for managing computer growth within their organizations. For the DP professionals, Nolan's stage concept is seen as an accurate predictor of an organizations computer growth, providing insight to the type of problems that they will face. Because of the model's wide spread acceptance in the EDP community, and the lack of significant non-corroborating evidence, Nolan's stage theory has been used in this thesis as the medium to portray the growth of computer resources within an organization.

acquisition justifications.) The variety of applications available and in use throughout the Navy is growing, however, the majority of microcomputers are being used as office automation devices vice decision support aides.

Management of microcomputers came under the same policies and direction that governed the acquisition and use of general purpose automatic data processing equipment (ADPE). In 1980 the Naval Data Automation Command (NAVDAC) selected the Navy Regional Data Automation Center (NARDAC), Norfolk, Virginia, as the Navy's center for microcomputer management. NARDAC, Norfolk's role in the Navy's microcomputer program is as an advisory organization, not a rule making body.

As a step to prevent the proliferation of a variety of microcomputers into the Navy, the Navy, together with the Air Force, contracted with Zenith to provide both the Navy and the Air Force with microcomputers. Navy units requesting a microcomputer other than a microcomputer available under the Navy/Air Force umbrella contract, must justify the non umbrella contract microcomputer in the Mission Element Needs Statement (MENS). If a non umbrella contract microcomputer can be justified, the requested microcomputer can be purchased, otherwise the unit must purchase a microcomputer from the umbrella contract.

Since the Zenith contract took effect in October 1983, 9,067 Zenith microcomputers have been purchased at a total

cost of $20,229,846.00.[3] Although microcomputers were making their way into the Navy, it was not until the Navy/Air Force umbrella contract with Zenith that the influx of microcomputers into the Navy began.

The Navy is now in a position such that they are trying to maintain control over the proliferation of a variety of microcomputers. The Navy/Air Force umbrella contract with Zenith is an attempt to hold the Navy to a single standard in hardware. There are efforts throughout the Navy to establish standards in software and training. However, there needs to be a central plan for the Navy's microcomputer management program.

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[3]These figures include both the Z-120 and tempest approved Z-150 microcomputers sold to the Navy from October 1983 through May 1985.

III. DISCUSSION

A. POLICY AND CONTROL

1. The Corporate Environment

Microcomputers have found a niche throughout a wide variety of American businesses. Companies such as Firestone Tire and Rubber, Portland General Electric, Chevron, and Petrolane Inc. have integrated microcomputers into their businesses. Other organizations such as the U.S. Bureau of Census and the University of Delaware have also discovered that microcomputers have found a place in their work environment. Even a body as staid and conservative as the U.S. House of Representatives is beginning to see the infusion of microcomputers into its offices and committees. "The figures speak for themselves. Last year (1983), the number of microcomputers owned by the First National Bank of Chicago jumped from 70 to 200 and the bank is bringing in five to ten new machines each week. And, in Hartford, CT, Travelers Insurance Co. has 13,000 microcomputers on order or already installed, and expects to buy about 12,000 more within the next five years." [Ref. 6]

Although these organizations are different in size, corporate structure, and mission, they all face the challenge of introducing a new technology in a manner that will

most benefit their organization. There are problems that are particular to each individual organization, yet many of the obstacles are similar to all of the organizations. These difficulties are handled in several ways, and are influenced not only by corporate thinking, but also by experience based on past computing decisions.

Microcomputers in the work place is a relatively new occurance, having its start in the late 1970s and early 1980s. Many organizations were first introduced to microcomputers by employees who brought their own microcomputers to work. The U.S. Bureau of Census [Ref. 7], was introduced to microcomputer technology in 1982 by Bureau personnel. With the aid of a "home" microcomputer, statistical analysts were able to finish in a very short period of time, a job that historically took a year to complete. This prompted others within the Bureau to look at microcomputers for help in the Bureau's work. Now there are over 500 microcomputers in use throughout the Bureau's central headquarters and 12 regional offices.

Other organizations have been nudged into microcomputer technology because of internal problems associated with their mini- and mainframe computer operations. At Firestone Tire and Rubber [Ref. 8], users were experiencing a backlog in requests for applications of 2 1/2 to 3 years. Management wanted to lessen the work load placed on the

mainframe and felt that microcomputers would be a good way to implement this decision. Since 1982 Firestone's End-User Computing department has installed over 500 microcomputers, and does not yet predict a drop in microcomputer growth. Firestone estimates that by late fall of 1985, their inventory of microcomputers and software packages will increase by 45% and 65% respectively.

The biggest push for the use of microcomputers at Firestone came form the departments receiving large time sharing bills from the company's Management Information Services department. Many of the applications were "what if" tasks that departments felt could be more efficiently run on microcomputers. Microcomputers were viewed as a tool that Firestone managers and analysts could use to maintain their creativity and, at the same time, better control their budgets.

At the Association of American Railroads [Ref. 9], microcomputers were introduced so that researchers would be able to free themselves from mainframe problems. If the mainframe went down, the Association's work would not grind to a halt. Preliminary work could be done on the microcomputers, with later stages moved to the mainframe when the power of the mainframe was required.

Many of the organizations realized that they would have to place some control on the acquisition and use of

their microcomputers. Although this is the predominant policy throughout, it is a thought that is not universally shared. There are several reasons for instituting a microcomputer policy. Among them is that the lack of a policy leads to uncoordinated actions by different managers, uninformed decision making, and an increased opportunity for the improper and inefficient use of an organization's resources.

In the U.S. House of Representatives [Ref. 10], because of the diverse interests of the 435 independent representatives and the 22 standing committees, it is felt that there can be no overall strategy for microcomputers. However, the House Information Systems (HIS) which operates in an advisory role, does promulgate a list of all office equipment that is approved for purchase. The HIS offers to members a wide range of computer tools while at the same time, attempts to provide a measure of control and accountablity.

While there is no formal written policy that governs microcomputer acquisition in the House, the control that HIS tries to impart on the members is a defacto policy, informal and perhaps not understood or realized by the members.

Some organizations have elected to start their microcomputer program with a "wait and see" attitude. They have decided to let the users establish the hardware and

software standards, and the applications. Portland General Electric [Ref. 11], a company of about 3,000, allowed its employees to integrate microcomputers into their work routine at their own pace. The company started by providing its senior executives with the company's first microcomputers. The executives were trained and given quick and effective assistance when required. A similar distribution policy was established with the next layer of management personnel. Some managers did not use their microcomputers, while the majority of the managers were using their microcomputers to varying degrees. Overall, the initial microcomputer introduction program was judged to be a success. As a result, management decided to allow other members of the organization to take advantage of the microcomputer's benefits.

Management of Portland General Electric was concerned about keeping the cost of the microcomputer under control. It was decided that Portland General Electric would pursue a coordinated, shared-environment of microcomputer use. They would let the employees, (the users) determine the best machine and most effective software. The microcomputers were placed in several centrally located areas throughout the company. Employees were not told how the microcomputers were to be used, but instead were allowed to use them in applications they thought most appropriate.

Management did not completely let the microcomputer users chart the company's strategy. Limited numbers of software packages were provided so that training problems would be minimized and, so that a conscious step would be made to establish software standards. To further promote software standards, management established a library of company approved software packages. Prior to obtaining their own software, employees were encouraged to try a library software package to determine its applicability to their task. In addition to encouraging the use of similar software throughout the company, the library also reduced the cost of buying untested software that later proved unable to handle the application.

In 1980, a senior executive at Ford Motor Company [Ref. 12], introduced microcomputers into Ford by offering ten microcomputers to anyone in the company who would want to rent one at $200 a month. All ten microcomputers were quickly taken. When it was learned that the time to complete a task by a financial analyst was reduced from a day-and-a-half to 30 minutes with the help of a microcomputer, the demand for microcomputers from the rest of the company grew. By 1982, microcomputers were being purchased at the rate of 100 per month.

In the beginning of Ford's microcomputer program, the only criteria for having a microcomputer was having the

funds to support (purchase) it. As the number of microcomputers grew throughout the company, Ford started to come head to head with the problems associated with uncontrolled microcomputer growth. There was a severe compatibility problem. Not only was there considerable difficulty in linking the company's different microcomputers together, but there was also a significant training problem. Employees had to be retrained not only in how different machines were operated (turned on and off, keyboard familiarization), but also on how to use the many different kinds of software that had proliferated throughout the company. An additional problem was the cost of microcomputer maintenance. Ford discovered that because it had not established a maintenance contract for the entire company, individual departments and users had contracted for their own maintenance contracts. The individual service contracts were a waste of money when a more economical company wide maintenance contract could have been arranged.

The problem of compatibility, training, use of hardware and software selection, while at first are not significant, can with time, as the number of differing systems grow, become almost insurmountable. Additionally, microcomputer technology is a rapidly growing and changing industry. Today's standard can become tomorrow's antique. With such fast pace growth, an organization must ensure that the

microcomputer it is purchasing today will not soon become obsolete. The improvement from 16-bit to 32-bit microcomputer technology will in itself prompt some personnel to attempt to upgrade their system. Without some form of control, an organization could expend a great deal of capital just to maintain itself on the technological edge.

Linking microcomputers with the current mainframe is another unseen problem. One of the advantages of the microcomputer is the ability of an individual to use it at will. However, a like advantage is made when the results of the microcomputer's work can be uploaded to the mainframe for corporate use or for more powerful processing. If an organization does not look at mainframe and microcomputer compatibility, it is giving up a very powerful and useful combination of organization resources.

The cost of microcomputers is not a trivial matter when considered on an organization wide scale. The cost of a microcomputer such as the IBM PC including color monitor, keyboard, dual disk drive, and a medium quality dot matrix printer is approximately $2,500. When purchased as individual systems, the $2,500 figure is not a lot of money. However, when microcomputers are spread throughout a company and they number into the hundreds, the $2,500 cost of a single microcomputer quickly takes on the aspect of a large investment of corporate resources.

There are additional costs associated with microcomputers that are not always visible. The cost of software, extra disk storage, printers, and modems will add up to a large figure when taken over an entire organization. The cost of a quality word processing package can run into the hundreds of dollars, as can the cost of high speed modems.

Corporations are spending considerable sums of money on their microcomputer programs. Portland General Electric has budgeted a half a million dollars for its 1985 hardware and software purchases. From 1982 until May 1985, Firestone Tire and Rubber Company has invested 2.5 million dollars in their hardware and software for microcomputers. However, their microcomputer growth will not subside. By the last quarter of 1987, Firestone expects to double its present microcomputer hardware and software expenditures.

At $2,500 a unit, many users and managers are asking why the purchase of a microcomputer should have to be justified. The question that should be asked is, "Now that I have the funds to acquire a microcomputer, should I?" In other words, Is there sufficient work to justify the cost of the microcomputer? Even if there is a documented need for a microcomputer, will there be people motivated to use the microcomputer? In some cases the answer to both questions is no. "Studies have repeatedly shown that (microcomputer) usage tapers off after one year" [Ref. 13]. To prevent a

"keeping up with the Jones" attitude on microcomputer acquisition, controls have been established that attempt to prevent unnecessary purchases. The controls force requestors to examine their jobs and make a determination on the profitability and applicability of acquiring a microcomputer.

Firestone Tire and Rubber company issued a very strict acquisition policy. The bottom line was that each microcomputer related purchase would have to be justified to, and approved by, corporate MIS. In the written justification, requestors had to provide a projected time savings and had to show an expected productivity increase or a cost savings as a direct result of a microcomputer purchase. Additionally the microcomputer would have to earn a 16% return on investment. Firestone had taken an overall company wide view of microcomputer acquisition. These requirements were typical of requirements that management normally required for capital investments in excess of $50,000. "It was felt that in the case of the (microcomputer), it was very important that (users) justify equipment. Because when you start adding all these little lumps together, you get a big lump."

Significant to the successful integration of microcomputers, as is the case for many other technical assets, is a training program. Many organizations have discovered

that educating its personnel is a key factor to be considered when instituting a microcomputer policy. Users are encouraged, and in many organizations, required to attend organization sponsored training sessions prior to useing a microcomputer. The courses cover subjects as simple as how to turn a microcomputer on and off, to more difficult ones such as how to use different applications, and the more complicated subjects such as programming. As important as training end users on how to properly use their systems, management is also educated on the use of microcomputers, and the impact they have on the organization.

While many people are aware of microcomputers, they are not fully aware of microcomputer capabilities and limitations. Rochester Methodist Hospital [Ref. 14], of Rochester, MN, in an informal survey of other hospitals discovered that user expectations often times overestimate the capabilities of microcomputers. But at the same time, many new users were not fully taping the potential of their microcomputers because they did not possess the required skills nor a proper understanding of its uses. Rochester Methodist Hospital decided that education of its staff would be a key plank in their microcomputer plan. Not only did they teach the mechanics of machine operation and software use, but they also decided to institute and stress the hospital's reasons for using microcomputers.

Because the microcomputer is becoming so prevalent, and because of the potential benefit an organization can receive from a properly used microcomputer, training is receiving a strong push. INTEL Corp. [Ref. 15], depends upon microcomputers in their maintenance program, production process, and scheduling. At first they were regarded as nice to have because they made tasks easy to accomplish. But as their numbers grew, and the users became accustomed to using microcomputers in the normal course of their jobs, microcomputers became essential tools. Although INTEL has been using microcomputers for just a short while, management estimates that without microcomputers, INTEL would need 10% more personnel to do the same work that is now being done with microcomputers.

To ensure that INTEL employees properly use their microcomputers, INTEL has established an extensive training program. There is formal class room training for all users, and executives are offered one-on-one training. Also, a user in each department or work area is given special training so that he is able to take care of routine problems from users in his work area. This saves workers the frustration of having to deal with corporate MIS when difficulties arise, and frees MIS for more difficult problems.

Users are often times required to attend mandatory training sessions prior to receiving microcomputers. The

University of Delaware requires all of its professors who want to become involved in the University's microcomputer program to attend a mandatory training program. Without the training, the staff are not allowed to have access to university microcomputers.

To help maintain standards, establish controls, and disseminate information both up and down the organization hierarchy, some organizations have established microcomputer user groups or steering committees. The responsibilities and authority of the steering committees vary from organization to organization. In some organizations the steering committee is merely a large meeting held periodically to exchange ideas on microcomputer use and to announce corporate policy. Other organizations have established microcomputer steering committees that play an active role in their organization's microcomputer program.

At Price Waterhouse [Ref. 16], the steering committee is used to formulate policy recommendations for upper management consideration. The committee reviews issues such as networking standards, hardware standards, office automation, maintenance control, future microcomputer growth, and software standards. Additionally the committee is responsible for reviewing software developed by users to ensure compliance with documentation standards, efficiency, and applicability to other areas in the organization.

Other organizations have found steering groups beneficial in evaluating different commercial software packages for use in their organization. They are often times tasked with evaluating and recommending new hardware systems and peripheral devices for organization use. Steering committees have been successfully used both as a policy making body and as an advisory group.

As a service to the organization end users, several companies have instituted computer stores. Employees are encouraged to come into the store and shop for the system that best fits their needs. Available in the store are company approved and endorsed software packages, and trained computer specialists who can suggest a solution to a user's request, while adhering to corporate policies. [Ref. 17]

An added benefit many organizations offer is that if an employee wants to purchase a microcomputer for his own use, the microcomputer can be bought in the company store. The employee will be able to use the store's library of applications on a trial basis prior to obtaining his own, and he will enjoy the same savings in cost on hardware and software purchases as does the company.

2. The Navy Environment

Microcomputers came into use in the Navy around 1978. Their use was spawned by the growing popularity of home microcomputers and the enthusiastic users who

envisioned the increased productivity a microcomputer would be able to provide. The demand for microcomputers grew faster than their integration because the acquisition process was not an easy exercise to negotiate. Inaddition, a difficult problem to overcome was the funding issue. But, in 1983, the Navy and the Air Force signed a contract with Zenith INC., to provide both services with microcomputers. This umbrella contract helped to ease the acquisition process and, as a result, started the influx of microcomputers into the Navy. Since the contract was let in 1983, over 9,000 Zenith microcomputers have been purchased by the Navy.

The Navy is faced with the problem of how to effectively deal with the microcomputer technology, and is facing the same problems as corporate America. The Navy is a large organization, dispersed in varying concentrations throughout the world. Microcomputers are spreading throughout this organization, and if not properly managed, microcomputers will absorb a great deal of funds and management time.

The Navy presently has a variety of instructions prescribing the policies and procedures that govern the acquisition and management of Automatic Data Processing (ADP) resources. These instructions also apply to the acquisition and purchase of microcomputers. Due to the relative low cost of microcomputers, and their simplicity as

compared to the more complex mini- and mainframe computers, some of the requirements of the approval and documentation process have been altered. The most significant alterations are in the documentation needed to receive authority to purchase microcomputers and in the source of funds.

Because of the demand of fleet units to be able to purchase microcomputers, the microcomputer policy has been geared towards giving the fleet units the authority and funds to purchase microcomputers. Getting microcomputers to the fleet is the dominant management issue.

The Navy wide contract for Zenith-120 and tempest approved Zenith-150 microcomputers has helped to ease the problem of getting microcomputers into the fleet. When purchasing a Zenith microcomputer under the joint Navy/Air Force umbrella contract, units in the Pacific Fleet Surface Force do not have to submit an abbreviated system Decision Paper (ASDP). A Mission Element Needs Statement (MENS) submitted by message or letter format is all that is required. Sample MENS are provided to fleet units to assist in the preparation of their MENS, making the preparation a routine process. As the MENS is a management paper, brevity is encouraged. MENS are routinely approved, and authority to purchase follows quickly. USS JUNEAU (LPD 10) submitted a MENS for a microcomputer acquisition by letter dated 22 May 1985, approval for the purchase was granted on 6 June 1985.

The Pacific Fleet Submarine Force has submitted a standard MENS for all of the Force's submarines. The MENS gives all Pacific Fleet submarines the authority to purchase one microcomputer. If the command feels that it needs additional microcomputers, then it must submit a separate MENS with appropriate justification.

So, there exists a mechanism that allows a unit to obtain a microcomputer: Request authority to purchase a microcomputer, and submit an abbreviated MENS. It is a fairly simple process, and yet provides management a means to monitor and regulate the number of new microcomputers that enter the fleet.

An additional constraint on microcomputer acquisition is the limit in funds a unit may spend. A $3,000 ceiling[4] has been placed on the cost of a microcomputer purchased with operating funds (OMN). Funding guidance limits the total purchase cost if OMN funds are used for a microcomputer system to $3,000 per suite. Per suite means that when purchasing a new microcomputer system, the $3,000 limit applies to the total cost of all of the components of the system. This includes commercial software bought to meet user requirements at the time the system is purchased. Additionally, the system can not be broken down into

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[4]This ceiling is expected to be raised to $10,000 on 1 October 1985.

component parts to allow a purchase within the $3,000 ceiling. [Ref. 18]

The Navy has established a form of control on microcomputers by use of a limit in the cost of a single system and the requirement to submit a MENS to justify the use of a microcomputer. Because of the umbrella contract with Zenith INC., approval authority is only granted on requests for a Zenith microcomputer.[5]

There is no Navy wide guidance on how to use microcomputers. At present most microcomputers are bought for word processing, spread sheet, inventory, and database management applications. How they are actually being used, and if they are being used is not accurately known. Their use largely depends upon a command having a knowledgeable person willing to devote the time necessary to properly set up and run the microcomputer.

Training is also a part of the Navy microcomputer program. NARDAC, Norfolk, Va., offers various types of training courses that are designed to familiarize users with the basics in microcomputer operation, and how to use commercially available software packages. There is an Introduction to Microcomputers course, and courses that are designed to teach users how to use software such as

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[5]If a microcomputer other than a Zenith is requested, then a more detailed MENS specifically stating the reason for a non-Zenith microcomputer is required.

WORDSTAR, D-BASE II, LOTUS 1-2-3, MULTIMATE, and others. These courses are offered in Norfolk, Va., but NARDAC, Norfolk, Va., can provide on site training. In addition to NARDAC, Norfolk, other NARDACS have been tasked with providing training programs.

NARDAC, Norfolk, Va., offers a user hot line that can be called for assistance in solving microcomputer problems. They also publish a news letter titled "Chips Ahoy," that provides information on current Navy microcomputer software and hardware. It addresses common problems experienced by users Navy wide, and keeps readers advised about training opportunities and other microcomputer news items.

NARDAC, Norfolk also sponsors a library of software packages. The software available is advertised in "Chips Ahoy" and on an online bulletin board. The desired software packages can be down loaded via the online bulletin board or requested by mail. Most of the packages are commercial packages. However, the Navy has not issued a standard for programming development and documentation. As a result, many commands produce the same type of applications, but in a slightly different manner. Because of the lack of programming standards, portability of programs is low and software maintenance is greatly increased.

Microcomputers are becoming a part of the Navy environment, and the Navy is attempting to make the integration

as successful as possible. Controls have been established to monitor and regulate new acquisitions. Training has been set up that is designed to teach commercial software packages, and assistance is available through a 24 hour, on-line system to users having difficulty with either software or hardware. However, there is no central policy that provides direction for the use of microcomputers in the Navy. Microcomputers are entering the Navy because they are a new technology with the promise of great savings in office automation. Yet, microcomputers are not being used to their full potential because they are not being viewed from the proper perspective.

B. THE SYSTEMS VIEW

The successful integration of microcomputers into the Navy requires that Navy management look at microcomputers from a broad perspective. That is, the microcomputer should not be considered as a single unit operating in a stand-alone environment. To be sure, many microcomputers do and will operate separately from an integrated computing operation. However, the impact of microcomputers should be measured on a Navy wide scale.

To discuss microcomputers on a Navy wide scale means more than determining how microcomputers will be funded. It means that the Navy as an organization must be viewed as a system. "By a system is meant a set of components that work

together for the overall objectives of the whole." [Ref. 19]

The systems view is not an idea alien to the Department of the Navy. It is already a part of the Department's manner of conducting business. One need only look at the weapons systems and combat systems concepts on the ships of the fleet to see that the Navy employes the systems view.

A weapons systems is made up of several different components (systems in their own right) that operate together to achieve a goal. Some of the weapons systems components are the personnel who operate and maintain the system, the gun or launcher, the target tracking device, the projectile guidance device, and the weapon itself: separate entities that are interconnected to perform a goal. The performance of each component impacts on the performance of other system components and the total performance of the system itself. If the operator loads the wrong projectile, then, even though the target is properly tracked, and the launcher functions properly, the weapon may not impact the target, and the system will have failed. Destruction of the target is not just a function of the weapon's performance, but of the weapon systems' performance.

The weapons system is a member of the set of components that make up the combat system. The weapons system, together with search radars, sonars, communications

equipment, and ship control personnel combine to provide the ship its offensive power and the ability to defend itself. This combat system is also a component of the ship, itself a system made up of the supply, engineering, operations, navigation, and combat systems.

The systems view is not new to the Navy. It is well entrenched in Navy thinking, so it should be a natural step to apply the systems approach to the management of microcomputers in the Navy.

Viewed as a single, complete unit, the purchase and use of a microcomputer is a trivial process. The cost of a single microcomputer (including printer, operating system and a limited number of software packages) is approximately $3,000. Against the budget of the Department of the Navy, $3,000 is not a significant figure. However, the Navy has more than one microcomputer, and when the cost of all of the Navy's microcomputers is aggregated, the figure does become significant as compared to the Navy budget. Install just one microcomputer in each ship of a 600 ship navy, and the cost of microcomputers quickly jump from $3,000 to $1.8 million.

Although cost is a major consideration in microcomputer management, it is by no means the only issue. There are two main areas to investigate, the microcomputer system, and the impact of microcomputers on other components of the Navy.

The systems view of microcomputers looks at all of the microcomputers and the other components they interact with to accomplish the Navy goal. If microcomputers do not help in achieving the Navy's goal, then they should not be included in the Navy system. But, as a system themselves, a subsystem of the Navy system, microcomputers must also have a goal. As a single unit, the goal of a microcomputer may be to increase the productivity of a particular office. But on a larger scale, how is the microcomputer's goal defined? Is it to reduce paper work by X% throughout the Navy, or is it to increase the productivity of the Navy's administrative personnel? Without a goal or a mission, microcomputer management has no foundation upon which to formulate policy that will allow for the most beneficial use of the microcomputer resource.

Once the goal of microcomputers is defined, the components of the system can be coordinated and directed towards accomplishing the designated goal. With this goal in mind, management will be able to define the capabilities that the microcomputer will need to have to accomplish its mission. Issues such as what operating system should be used, how much memory should the microcomputers have, what type of printer will be required, what type of software packages will be needed, and how many microcomputers must be bought, will be able to be discussed and resolved.

There are other components of the Navy system that will be affected, and therefore must be considered when making microcomputer policy.

The introduction of a new technology will require a training program. Training will have to be initiated not only for new recruits, but also for the personnel who are already operating in the fleet. This could have a big impact on the training system. Dollars will have to be redirected from other programs to the microcomputer program, instructors will have to be identified, classrooms will have to be assigned, training aides will be required, lesson plans will need to be written. Instruction will have to be provided in many parts of the world to ensure that the largest number of people have the opportunity to receive the new training.

Some other more fundamental questions will have to be asked and answered. Will we have to change the way we do our jobs to accommodate the gaol that has been established for microcomputers? Commander, Naval Military Personnel Command (COMNAVMILPERSCOM) has established standards that are used throughout the Navy in administering Naval personnel. These procedures have been recorded in the COMNAVMILPERSCOM manual which can be found in every personnel activity in the Navy. The COMNAVMILPERSCOM manual provides instruction on what information is needed to fill

outs forms and how to fill out the forms. With the use of microcomputers, what portion of the COMNAVMILPERSCOM manual will have to be rewritten? Will it have to define data elements, length of data elements, key strokes to save files, or how to make changes in files? The manual will have to identify what jobs will be done on a microcomputer and what jobs should be done as they are presently being done.

To be able to properly align the power of the microcomputer with the needs of the user, a requirements analysis must be made. There are two areas that will need to be investigated; end user requirements and job requirements.

In defining end user requirements the Navy must determine what prospective microcomputer users do in the daily execution of their jobs, and how they execute their jobs. An important variable to quantify in defining the user's microcomputer requirements is the amount of time a user spends on a particular task, and the impact that task has on the accomplishment of his job. By understanding the job of the user, a system can be designed to most effectively assist the user in his job.

The needs of the task must not be overlooked. Tasks identified by users as the most critical or the most time consuming must be evaluated for accomplishment on microcomputers. A great many tasks will be able to be run on

microcomputers, however, there will remain some jobs that are better done as they are now. A task that requires little time to accomplish, yet is critical to mission achievement, may not need to be automated. But, a non-critical task that is time consuming to accomplish may be better done on a microcomputer. The importance and time a job consumes must be balanced with the investment the organization is able to make. It may well be that although a particular job performs a number of critical tasks, the time to complete the tasks is so minimal that automating the job on a microcomputer in not warranted.

As a result of the requirements analysis, the Navy will be able to provide strong direction to its microcomputer program. Hardware and software will be identified or designed which will best meet the needs of the user, and training will be structured to concentrate on the jobs with microcomputer application. By defining where microcomputers are to be used, and how they are to be used, the Navy will be better able to use its microcomputer resources in accomplishing the Navy's mission.

Microcomputer management is more than just identifying hardware and software and overseeing their integration into the fleet. It also includes coordinating the new technology with other components of the Navy. Ensuring that microcomputers are properly supported by other navy components, and

that microcomputers are being properly used to accomplish their goal and the Navy's goal. With the systems view, the proper perspective of microcomputers in the Navy can be seen. It is more than just several microcomputers operating independently in the fleet, it is a large investment in financial resources and personnel that impact throughout a wide variety of areas in the Navy.

C. MICROCOMPUTER INFUSION AND DIFFUSION

The planning for information systems varies in accordance with the experience and technology an organization possess in information systems. Two factors that can be used to determine the planning methodology an organization should use are infusion and diffusion. Infusion is the degree to which information technology has penetrated a company in terms of importance, impact, or significance. Diffusion is the degree to which technology has been disseminated throughout the organization in terms of the physical dispersion of hardware, and in respect to the amount of decentralization the organization has placed on control and responsibility of its information system. [Ref. 20]

An organization with a low degree of infusion does not view computer technology as having a strategic impact on the organization's mission. Although computer technology is used in the organization, it is viewed as a support function not critical to the organization's success. Organizations

with low infusion tend to have their computer technology concentrated in jobs typified by payroll, accounting, and administrative applications.

An organization with high diffusion is one that has dispersed its computing resources throughout its organization, as compared to a low diffusion organization which has concentrated its computing operation and maintains centralized management control.

The Navy is an organization with low infusion and a moderate (neither low nor high) degree of diffusion in respect to microcomputer technology. Infusion is low because the Navy does not see microcomputers as essential to their mission. They are presently viewed as tools for individual commands to use to increase workers (in clerical ratings) productivity. Microcomputers are not seen as strategic to the Navy mission, because without microcomputers the work will still continue to be accomplished.

The present view of microcomputers does not however, prevent the degree of infusion from rising at a later time. As the Navy becomes more experienced with microcomputers and begins to rely upon them to ease and reconfigure the administrative work load and thus allow the Navy to more aggressively pursue its mission, the strategic importance of microcomputers will change. Should manning levels be reduced, or should there be a need to increase the number of

personnel in warfare related ratings, then the increased productivity of the clerical ratings as a result of the use of microcomputers, will permit a reallocation of personnel from the clerical ratings into the mission essential ratings.

The moderate degree of diffusion of microcomputer technology is primarily generated by the physical distribution of the Navy's microcomputers. Although the technology is geographically dispersed throughout the fleet, there is still a great deal of centralized control. The line managers, that is, unit commanding officers, are given a very limited degree of freedom in putting together a microcomputer system that will effectively meet their unit's information system needs. Even if that freedom was available, there are not enough line managers with the knowledge necessary to design and operate an effective information system.

As more microcomputers spread into the fleet and fleet units learn how to effectively use the computing power, the degree of diffusion of microcomputer technology in the Navy will change. Diffusion will also increase in the sense that the organization's degree of control and responsibility for the Navy's microcomputer technology will pass to unit commanders.

At present, low infusion and moderate diffusion indicate that an appropriate methodology for planning is Nolan's Stages of Growth. The stages of growth accurately portray the situation the Navy microcomputer program is in, (expanding growth with management attempting to control the growth) and provide guidance on appropriate steps to be taken to integrate microcomputer technology into the fleet. Additionally, the stages of growth represent a method of education for managers at all levels of responsibility on the control and use of microcomputers in pursuit of the Navy's mission.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The management of a new technology such as microcomputers is a time consuming and complicated process. In the Navy, the process is covered by a variety of instructions that provide guidance for the acquisition of microcomputers, but guidance for the proper use of the new technology has not been provided. The guidance pertaining to the acquisition process has been successful in providing fleet units with the opportunity to purchase microcomputers. However, the lack of guidance in the proper use of microcomputers to accomplish specific mission needs and objectives has nullified much of the benefits expected to be accrued by the fleet's microcomputers.

1. Acquisition of Microcomputers

The acquisition of microcomputers has become a routine process. The paper work for a command's first microcomputer has been greatly simplified, requiring the submission of a preformatted MENS as the requesting and justifying document. Acquisition approval is normally granted provided that the requested microcomputer is ordered under the appropriate Zenith umbrella contract (Tempest or non-Tempest approved), and that the aggregate cost of the

system is under the present monetary ceiling ($3,000). Funding for microcomputers comes from individual unit operating budgets.

A request for additional microcomputers requires the submission of a separate MENS for each system with specific justification for each additional microcomputer.

2. Standardization

A key plank in the management of microcomputers for afloat units is the standardization of hardware and software [Ref. 18: p. 1-1]. The standardization of hardware is being enforced by the requirement to purchase microcomputers from the Zentih umbrella contract. There are only two types of microcomputers available on the contract, the Zenith-120 and the Zenith-150 which are compatible with each other. However, the issue of what to do with the other non-Zenith compatible microcomputers already in the fleet has not been addressed.

The standardization of software is a more difficult problem then hardware standardization. Because of the relative low cost of commercial software packages and their availability in the market, commands are obtaining the software they determine will best meet their needs. The Navy has not selected a specific software package such as WORDSTAR for word processing, or D-BASE III for database applications as a standard to be used by all afloat units.

The selection of a standard software package will allow for the establishment of standard methods of microcomputer use that can be taught in training programs and used throughout the fleet.

Development and documentation standards for user developed software has not been promulgated for use in the fleet. There exists no central clearing house for the evaluation and validation of user developed software. An organization as widely dispersed as the Navy must issue standards for development and documentation of user developed programs. This will increase the portability of the programs and decrease the maintenance problems associated with poorly documented software. A central clearing house for user developed software will act as an enforcing agent in development standardization. It will also help disseminate useful software to other commands and thus reduce the redundancy caused by the proliferation of similar programs all done in a different manner.

3. Training

At the heart of every successful microcomputer policy, is a user training program. It is important that the training program include basic principals of microcomputer operation such as, turning the machine on and off, the proper care of the machine, how to insert and remove memory disks, and keyboard familiarization. Additional instruction

is needed in application management, that is, the selection and use of commercial software packages. This type of instruction should form the foundation of the training course, for this is the mechanics of microcomputer operations. However, learning the mechanics is not enough, users must be taught how to apply the mechanics to accomplish their jobs. The main thrust of the training must deal with how to use the software packages so that not only is generated output consistent throughout the organization, but more importantly, so that more organizational resources can be devoted to the accomplishment of the Navy's mission.

The basis of the Navy's training program is teaching the mechanics of microcomputer operations. There is not enough emphasis on the proper application of the mechanics in accomplishing the Navy's mission. Although NARDAC, Norfolk, Va., offers a variety of training programs both at NARDAC headquarters and on site, microcomputer instruction has not been fully integrated with other related training programs. The opportunity cost of not providing proper training is the time lost from work as a result of needed unit training.

4. Full Integration

The Navy is making a large investment in microcomputers, both in dollars and in management time devoted to the effort. Great strides have been taken to get the

technology into the fleet, but efforts to effectively use the new technology have not been as successful. The present management concern is focused on the narrow view of getting the technology into the fleet and once there, letting the fleet determine its application. Little thought has been directed to the overall strategy of integrating microcomputers into the job of accomplishing the Navy mission.

Microcomputers have not been looked at as a total system. They are regarded as single, stand-alone units and therefor, management has not been able to see the total cost and impact that microcomputers are having on the fleet.

There are many areas in the Navy that are affected by microcomputer technology, yet are not receiving the proper management attention. There is no guidance on how to routinely perform personnel and administrative tasks on microcomputers, or how to use database software packages to manage personnel records. The use of microcomputers in the training program has not been fully explored.

By taking the systems view of microcomputer management in the fleet, management will be able to asses the full impact of microcomputer technology on fleet operations and thus establish comprehensive plans for further microcomputer expansion.

5. The Policy Issue

The original purpose of this thesis was to study the microcomputer acquisition process as practiced by the operating units of the fleet to determine the most expeditious way to get microcomputers into the fleet. It was felt that once in operation in the fleet, microcomputers would not require a great deal of management attention. Because microcomputers were so inexpensive, it was believed that individual unit commanding officers should be granted the authority to purchase the microcomputer software and hardware he felt would be the most economical and beneficial to their respective commands. The premise was that microcomputers should be handled with the same degree of management attention that the purchase of an electric typewriter receives.

The information learned through the research phase and the writing phase of this thesis has failed to support the idea that microcomputers do not require a comprehensive, overall policy of management and control. Microcomputers can not be viewed as single stand-alone units that have little or no impact on an organization. In purchase dollars alone, the aggregate cost of an organization's microcomputer assets can, and often does, reach into the millions of dollars. Coupled with the associated costs of peripheral devices and software, the hardware cost figure can raise by an order of magnitude or more.

Improper uses of microcomputers can become a waste sink for the one organizational resource that can not be regained, employee working hours. Uncontrolled proliferation of microcomputers leads to uncoordinated progress towards corporate goals, and in some cases, no progress at all.

To fully gain the most benefit from an organization's microcomputers, there must be a policy which provides management with control of the acquisition and use of microcomputers as well as providing users with the proper guidance in effective use of microcomputers. This will move the organization to higher degrees of infusion and diffusion which will cause microcomputers to impact on the strategic goals of the organization, as well as result in a true distribution of responsibility for the organization's effective management and control of microcomputers.

As illustrated in the second stage of computer growth, when left to their own, programmers will often times take on the assignments they feel are more important before they handle assignments that could be of greater benefit to the organization. By taking a systems view of the organization and its resourses, management will be able to channel the organization's use of its microcomputer technology in a manner that will most benefit the organization; accomplishment of organization goals.

B. RECOMMENDATIONS

1. The Long Term

The microcomputer is a powerful technology that can be of great benefit to the Navy. As presently managed, the microcomputer is not being used to the fullest of its potential. The Navy should asses the importance of the microcomputer in respect to the Navy mission. This will require a requirements analysis to better define the needs of the user and the jobs to be accomplished on microcomputers, as well as top Navy management having to look at the long term impact microcomputer technology will have on maintaining the combat readiness of the fleet.

As microcomputers are distributed to more units of the fleet and management is steadily shifted from centralized authority to knowledgeable fleet personnel, the strategic importance of microcomputers will increase. The Navy will have to abandon the stages of growth planning process and reevaluate its plan for microcomputer growth. It will have to anticipate the changes that improved technology will bring to microcomputers and keep the plan in step with the users' ability to adapt to the changes, and the speed of the changes. The long term goal of Navy microcomputer planning should be the establishment of local area networks with the capability of joining to form a large area network.

2. The Short Term

There are several areas in which the Navy should take immediate action. The implementation of software standards should be a key priority. Of the commercially available software packages, the Navy should identify a particular brand each for word processing, inventory management, database management, and spread sheet applications as Navy wide standards. Authority to copy and distribute the software should be obtained from the respective software houses. All afloat units should be required to use the Navy standard software packages in their microcomputers.

A programming and documentation standard should be issued to all commands. To enforce the standards, a central clearing house for user developed software should be established. The user developed software can be tested for compliance with promulgated standards and evaluated for applicability as a fleet wide software package. Additionally, the audit of a command's microcomputer program should be included in the Command Inspection Program.

Hardware standards should be established by selecting a particular microcomputer as the Navy standard, and insist that all future microcomputers purchased by the Navy are compatible with the Navy standard.

Microcomputer training should be included in the basic training program of all clerical ratings. The

training should teach the mechanics of microcomputer operations as well as a uniform method applying the mechanics in the accomplishment of standard Navy jobs. Training should also be provided to middle managers such as chief petty officers and junior officers. The focus of the training should be directed toward the use and the management of the technology in the achievement of goals.

Other commands should evaluate the procedures necessary to the accomplishment of their tasks to determine if the jobs should be automated on microcomputers or continue to be none in the present manner. If the jobs can be applied to microcomputers, instruction on how to do the task using standard Navy hardware and software should be issued.

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